

or of the Confoco-ellipsoidal structure of the shells of the Foraminifera), which remained infructuous in the hands of its distinguished author, has served to set in motion a train of thought and propagated an impulse which have led to a complete revolution in the whole aspect of modern analysis, and will continue to be felt until Mathematics are forgotten and British Associations meet no more.

J. J. SYLVESTER

TECHNICAL EDUCATION

MANCHESTER at all events is beginning to be alive to the present situation, and at a meeting on the 18th inst., the following document, expressing the views of the Council of the Society of Arts, was read.

1. The Council of the Society of Arts have received a communication from Owens College Extension Committee, Manchester, asking their co-operation in the extension of technical education, or, more properly, Scientific Instruction; and it affords them much pleasure to do whatever lies in their power to advance this important national object. With this view, the Council have invited the members of the Society, and especially those resident in the locality, as well as the authorities of Owens College, to meet them in conference on the subject, to discuss the best means by which scientific instruction may be promoted, and to establish an organisation which will keep an influence at work to accomplish what is so urgently needed.

2. The necessity and importance of improved scientific instruction for the people of the United Kingdom, in order that they may be placed in a favourable position in the race of industrial competition with other nations, has, for some time past, been forced upon the notice of the Society of Arts, whose chartered objects are the Promotion of Arts, Manufactures, and Commerce.

3. The great international displays of industry in 1851, 1855, 1862, and 1867, have shown unmistakeably that, if this country is to maintain her position as a commercial and manufacturing power, the people (and in this term are comprehended not only artisans, but also persons of higher position in the social scale) must have at their command the means of education improved in its general character, and embracing, if not based upon, science to a far greater extent than has hitherto been the case. The official jury reports at all the exhibitions abound in declarations of this character, and the country can no longer afford to ignore the fact, but must earnestly set to work to bring about a change. These reports, as well as those of the artisans who were sent to the Paris Exhibition of 1867 by the Society, one and all point out the great educational facilities which are available for all classes, and especially the artisan class, upon the Continent.

4. The Council are of opinion that existing schools and colleges, where science has hitherto been all but excluded, should adopt some means for its being taught; and that where such teaching already exists, measures should be taken for extending the usefulness of the institutions, and rendering them more easy of access to the great body of the people; whilst in localities where no such facilities exist, means should be taken to secure their foundation. The localities must themselves stir in this reform, and their efforts should be aided by pecuniary assistance and countenance by the State.

5. The nation must set itself earnestly to work to bring about the sought-for change in the education of the people. The evils have been so often pointed out, that it is unnecessary to enter into detail; our duty is to supply the remedy. This the Council believe to be by the localities setting themselves heartily to work, and when they have shown themselves in earnest by raising funds and organising establishments for the teaching of science, they should be entitled, as of right, to aid from the State.

6. In order, however, that such establishments, colleges, or schools should be of value to the mass of the people, so that they can take advantage of the facilities which would then be offered to them, it is absolutely necessary that elementary education, commonly known as primary education, should be extended far more widely than at present. To an ignorant population the establishment of colleges and schools for the teaching of science will be of little avail, and unless the blessings of an ordinary elementary education, *i.e.*, reading, writing, and arith-

metic, at least, can be more diffused, so as to place our people on a par with those of Switzerland, Prussia, Saxony, &c., the attempt to extend the teaching of science will be in vain. Again, not only must we have improved elementary education, but these elements must themselves be taught by improved methods and organisation, so that less time may be occupied in acquiring them, thus leaving free for the learning of elementary science some of those years which are now unnecessarily taken up in mastering the mere rudiments of knowledge. Abroad it is the custom of the State only to deal with this and many other matters of public concern, but such is not the case here. The Council do not recommend State interference as of choice, but of necessity. This work of education must be done, and will have to be done, wholly by Government, if not otherwise. Experience proves that it can be done by a combination of voluntary efforts with Government aid, as in the existing system of primary education, and in the instruction aided by the Science and Art Department. The Council think that the work is to be done in part nationally, in part voluntarily, but not upon a haphazard system.

7. Adam Smith, the earliest, and, perhaps, the first English writer on political economy, as well as Mr. J. Stuart Mill, its present most able exponent, recommend scientific instruction as profitable to the nation. Her Majesty's Government must not plead economy as an excuse, for the highest and wisest economy comes out of wise expenditure.

8. The Council believe that this is the feeling of the country, which the Government will regard with respectful attention. Government must be urged to co-operate with Owens College and other bodies, either existing or to be established. Parliamentary grants are now made to the old universities of England and Scotland, and to the Queen's Colleges in Ireland, and there is no reason why the same principle should not be extended, and grants made to modern educational establishments in the great centres of industry. The Council are of opinion that a Government resulting from a wide representation of the whole people ought adequately to represent the highest intelligence and aspirations of that people for improvement, and not limit its responsibility and its labours to matters of police. There can be no more profitable investment of national capital drawn from taxes paid by the whole nation, than in promoting the best education among all classes of the people, and the widest extension of sound knowledge, on which the Arts, Manufactures, and Commerce of a kingdom rest.

At the meeting, the following resolution, proposed by Professor Jack, was carried unanimously:—

“That the best interests of the country demand the establishment of a complete system of primary education, the extension of the system of science classes under a responsible department of the Government, and under a definite plan, and especially the establishment of Science Colleges in the principal industrial centres of the United Kingdom: and such colleges ought to be established and maintained partly by local efforts, and partly by liberal assistance from the State; and existing institutions such as Owens College ought to be made available for the purpose.”

For the present, we content ourselves with chronicling these facts, and calling upon other centres of industry, such as Birmingham, to help to bring the pressure of public opinion to bear upon the members of the Government, who, perhaps, more than anyone else, require to be taught the vital importance of technical education to the future national life.

WHENCE COME METEORITES?

IN examining a mass of meteoric iron found in the Cordillera of Deesa (Chili), M. Stanislas Meunier, of the Museum of Natural History in Paris, has discovered evidences of an unexpected relationship between this iron and two meteorites fallen at a great distance from Chili; viz. a mass of iron found at Caille (Alpes Maritimes), and a stone which fell at Sétif (Algeria) June 9, 1867.

The meteorite of Deesa is a mixture of these two rocks: it is composed of iron which is identical with that of Caille, injected in a state of fusion into a stone which is identical with that of Sétif. The iron of Deesa is thus evidently an eruptive rock, and it is the first hitherto

observed among meteorites. Besides this, it is asserted that the iron resembling that found at Caille, and the stone resembling that of Sétif, have been mutually connected by stratification upon an unknown globe, and it is the first time that such a connection has been materially demonstrated.

M. Meunier remarks that the meteorites which now arrive upon the earth are not of the same mineralogical nature as those which fell in past ages. Formerly iron fell; now stones fall. During the last 118 years there have been in Europe but three falls of iron, whereas there have been, annually, on an average, three falls of stones. The greater number of meteoric irons, which exist in the Paris collection, have fallen on the earth at undetermined epochs; all the meteoric stones are of comparatively recent date. Perhaps we are even justified in saying that stones of a new kind are beginning to arrive, for falls of *carbonaceous meteorites* were unknown before the year 1803, and four have been observed since then.

From this assemblage of facts, M. Stanislas Meunier concludes that meteorites are the fragments of one or more heavenly bodies which, at a period relatively recent (for these waifs are never found except in superficial strata), revolved round the earth, or perhaps round the moon. Having, in the course of ages, lost their own proper heat and become penetrated by the cold of space, they have arrived, much sooner than the moon, by reason of their inferior volume, at the last term of the molecular actions which are operating upon our satellite, and which are rendered evident to our eyes by the enormous crevices, the deep fissures with which it is furrowed. Split in all directions, they have fallen to ruin, and their fragments, remaining scattered along the orbit, so as to form a circle more or less complete, have at the same time become arranged, according to their density, in zones concentric with the focus of attraction towards which they are constantly impelled by the resistance of the ethereal medium through which they move. The masses nearest to the centre, and which were principally composed of iron, were the first to fall; afterwards came the stones, in which period we now are. Hereafter, perhaps, will arrive meteorites analogous to our crystallised formations, and perhaps even to our stratified beds.

Thus meteorites, the veritable products of demolition, represent, according to M. Meunier, the last period of the evolution of planetary bodies. The incandescent orb, the sun, figures at the present day in our system as the sole representative of the primitive state through which the earth, and all the other bodies which revolve around it, have passed; the moon representing the future which awaits the terrestrial sphere, now in all the plenitude of life; and, finally, meteorites show us what becomes of the dead stars, how they are decomposed, and how their materials return into the vortex of life.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.]

Dr. Livingstone's Explorations.

It certainly is to be regretted that the information received from Dr. Livingstone should be so imperfect. Still, though insufficient in itself, perhaps, to warrant our arriving at any positive conclusion respecting his claim to have discovered the chief sources of the Nile, the information furnished by him affords material aid towards the solution of that great problem of African geography, and is generally of much greater value, in my estimation, than it would appear to be in that of your learned correspondent "F.R.G.S."

Before advertizing to the main subject, I desire to point out, in the first place, that Dr. Livingstone has definitively settled that the Chambeze—the New Zambesi of some of our maps—is not an affluent of the well-known river Zambesi, which flows eastward

into the Indian Ocean, but is a distinct stream, of which the course is to the west and north-west. On this point it is due to Mr. Cooley to say, that, although he was mistaken respecting the upper course of the Zambesi itself, he has long contended for the separate existence of the "New Zambesi," or Chambeze.

Secondly, Dr. Livingstone has ascertained that the Chambeze, in its lower course beyond the capital of the Cazembe, is joined by another large river, the Lufira, coming from the south and south-west, which drains the western side of the country south of Tanganyika, as the Chambeze drains the east side. The Lufira was not seen by the traveller; but when he was at some place, not named by him, in 11° S. lat., that river was pointed out to him as being at some distance west of that spot, and was described as being so large there as always to require canoes; for so I read his words:—"I have not seen the Lufira, but, pointed out west of 11° S., it is there asserted always to require canoes;"—which shows that it must come from a considerable distance south of that parallel.

In the next place, Dr. Livingstone informs us that the Chambeze enters Lake Bangweolo, and then changes its name to Luapula; that this river flowing north enters Moero Lake, and "on leaving Moero at its northern end by a rent in the mountains of Rua it takes the name of Lualaba, and passing on N.N.W. forms Ulenge in the country west of Tanganyika." This, it must be remarked, is not native information, but the result of the traveller's own personal observation on the spot. His letters are dated "near Lake Bangweolo;" and in speaking of the Lualaba he says, "I have seen it only where it leaves Moero, and where it comes out of the crack in the mountains of Rua."

To make it more certain that he is speaking of the Lualaba, and not of the Luapula, the traveller expresses his intention "to follow down the Lualaba and see whether, as the natives assert, it passes Tanganyika to the west, or enters it and finds an exit by the river called Locunda [or Loanda] into Lake Chowambe;" which lake, he says, "I conjecture to be that discovered by Mr. Baker;"—adding, "I shall not follow Lualaba by canoes," &c.

Nothing could well be more explicit than this. And yet your correspondent represents Dr. Livingstone as saying that "he saw the Luapula only at this gap in the mountains," and describes the Lualaba as being a month's journey further west, and as falling into the Lulua and so joining the Zaire, or great river of Congo, on the west coast of Africa. There must clearly be some mistake here.

I think, too, there must be some misapprehension respecting "the great salt marshes, which chiefly supply the interior of Africa," described by "F.R.G.S." as situated on the banks of the Lualaba, a great running stream of fresh water. Is it not more likely that those salt marshes lie in some extensive depression in the interior of the continent, having no outlet, but in which the rivers that may flow into it are absorbed and lost?

Further, according to Dr. Livingstone, the Lualaba, after leaving Moero beyond the town of the Cazembe to the north, forms Ulenge, either a lake with many islands or a division into several branches, which are taken up by the Lufira. This I understand to mean, that the junction of the Lualaba and the Lufira is in Ulenge, north of the Cazembe's residence. "F.R.G.S." says, on the contrary, that the Lufira "flows into the Luapula from the west about 100 miles S.W., or S.S.W., from the Cazembe." How are these two statements to be reconciled?

Then "F.R.G.S." says, "When our author speaks of the Luviri (Lufira) entering Tanganyika at Uvira, he evidently casts the dimly discerned views of the natives into his own preconceived mould, and clothes them in his own language." But Dr. Livingstone could scarcely have had any "preconceived" notions on the subject, unless he took with him Mr. Cooley's map of 1852, in which the Chambeze, under the name of the New Zambesi, is laid down as joining the Luviri and then, under the name of Luapula, falling into the lake of "Zanganika" on its west side in about 8° S. lat. And this opinion Mr. Cooley would seem to regard still as the correct one; for in a letter which appeared in the *Daily Telegraph* of the 27th August last, with his initials "W.D.C.," he expressly states that "the drainage of the Cazembe's country is all into the Nyanza on the east." Though why this name should be applied to the Lake of Tanganyika is not patent. We know the "Victoria Nyanza" of Speke, the "Albert Nyanza" of Baker, the "Lake Tanganyika" of Burton, and the "Lake Nyassa" of Livingstone. We also know that in Mr. Cooley's maps of 1845 and 1852, Tanganyika and the more southerly Lake Nyassa are made to form one continuous body of water under the name of "Nyassa, or the Sea." But the present